

SABIC
Innovative
Plastics™



Specialty Film & Sheet



Keeping technology moving

Lexan* and Ultem* film and sheet

Advanced engineering materials for the transportation industry

Sharing our futures

Introduction

From innovative glazing to trendsetting interior components, SABIC Innovative Plastics business is serving the global transportation industry with a broad portfolio of advanced engineered thermoplastic resin, sheet, and film materials. These include products developed for both interior and exterior use, representing a total-solutions approach to meet this industry's rapidly expanding needs with high materials technologies.

SABIC Innovative Plastics' Ultem* and Lexan* resin-based sheet and film materials are finding ever-expanding use in the transportation industry. Ultem polyetherimide (PEI) sheet, offers excellent properties, including inherent flame resistance with low smoke emission, high strength, and broad chemical resistance. Lexan polycarbonate sheet—an extremely durable material based on SABIC Innovative Plastics tough, virtually unbreakable Lexan resin—combines crystal-clear transparency with value-added performance that features light weight, high stiffness, design freedom, impact and fire resistance, and weatherability.

Combining thermoplastics expertise with in-depth knowledge of industry standards, regulations and trends, SABIC Innovative Plastics' business is committed to keeping its customers in the transportation industry at the leading edge of materials and processing technology. From its state-of-the-art Customer Innovation Centers around the world, the company provides customers with access to a full range of laboratory, testing and design services, complemented by local hands-on technical support.



Maintaining appearance and performance over the life

To avoid high maintenance or replacement costs for glass, many transportation companies select Lexan* sheet for its extremely high impact resistance, high resistance to abrasion, and high resistance to the effects of weathering and yellowing caused by exposure to UV radiation in sunlight. Backed by a 5-year limited written warranty against loss of light transmission and coating failure, Lexan Margard* sheet also offers a 10-year limited written warranty against breakage.

Another example, Ultem* opaque sheet not only meets railway interior industries demand for exceptional cleanability but also offers durability. Lexan Margard and Ultem sheet are both flame resistant and make excellent candidates in applications requiring protection against vandalism. Each also minimizes the risk of costly re-glazing, and allows frequent cleaning or removal of graffiti without sustaining damage.

Keeping costs in line

In addition to their strong resistance to breakage, weather damage and vandalism, Ultem and Lexan sheet can both help to deliver measurable return on investment through ease of installation.



Airbus 380 early interior concept design



Enabling creative design

While the characteristics of glass – weight and brittleness – limit its design versatility, Lexan® sheet products can provide high optical quality and exceptional design freedom mainly due to their light weight, ability to be formed and bent into complex shapes, and the many different colors, textures, and special effects they offer. Coatings for superior weatherability, heat management, hardness, and other customizations can also be selected to differentiate or enforce a design. Lexan sheet is available both in opaque and transparent forms.

Comfortable and safe interiors

A well-designed interior offers a high-quality experience, including temperature, light, and sound control. SABIC Innovative Plastics' transparent and translucent Lexan sheet products are excellent candidate for windows and light diffusers.

Also terrorism, crime, and natural disasters such as hurricanes have led to increased demand for glazing solutions that help protect people, property, and critical infrastructure. The use of glass can be problematic due to breakage that causes injury and requires re-glazing. SABIC Innovative Plastics' line of transparent armor laminates have been engineered to help defend vehicles—and their occupants—against ballistic impact, forced entry, and bomb blast. Together with Lexan Margard® sheet, these products may help provide greater safety, protection, and peace of mind in a wide range of threatening situations.



Airbus 380 early interior concept design

The vast technical resources of SABIC Innovative Plastics make it easy for customers to obtain the support, customized products, and design assistance needed to complete projects on time and meet stringent specifications. Based on high performance Lexan® polycarbonate and Ultem® polyetherimide resins, the broad portfolio of solid sheet products is helping customers around the world to develop lightweight, durable parts with tailor-made performance, each with different properties and attributes.

Interior applications and claddings

SABIC Innovative Plastics can offer a range of innovative opaque sheet materials for the new interior applications in a large array of vehicles, ranging from train seating, to aircraft wall panels and specialty vehicle cladding. SABIC Innovative Plastics' opaque and translucent material portfolio may offer not only common interior application necessities but also specific industry requirements.

Opaque sheet portfolio features

- High heat and flame resistant materials passing the increasingly stringent requirements of specifically the air and rail industries
- High chemical resistance to many chemicals such as cleaning fluids, paints and adhesives.
- Light weight composites (0.6-0.9 specific gravity) with decorative skins
- Range of colors
- Surface and in-mold decoration SABIC Innovative Plastics is working in close cooperation with coating and decorative foil suppliers to develop aesthetically appealing solutions which may also provide differentiated aesthetics and graffiti resistance for the new composite materials
- In-mold decoration with Lexan film and injection molding resins for smaller and medium size parts where large production number are required.
- Thermoformable solid sheet and composite materials

With over 40 years of experience in developing leading-edge thermoplastics technology, SABIC Innovative Plastics is a supplier of a broad product portfolio that can offer an expanding range of performance, processing and aesthetic options for thermoforming applications. We continue today to pioneer state-of-the-art materials and process technologies for this market.

Lexan Polycarbonate, Ultem Polyetherimide sheets, and Azdel® composites all make excellent candidates for thermoforming. They offer broad processing windows, even shrinkage, and the ability to consistently create dimensionally stable parts. Due to the ductile characteristics of these products, secondary operations such as drilling, sawing, and ultrasonic welding can be performed with conventional machine tools. Plus they can be easily bonded and painted using a variety of systems.



SABIC Innovative Plastics continues to meet the transportation industry's challenge to provide glazing materials of the highest optical quality, whilst meeting specific industry requirements.

Virtually unbreakable, high optical quality Lexan® polycarbonate (PC) sheet materials from SABIC Innovative Plastics are often a top choice due to the versatile glazing solutions that they may help provide. Lexan polycarbonate sheet combines crystal clear transparency with value-added performance that features light weight, high stiffness, design freedom, impact and fire resistance, and weatherability. This high-tech solid sheet product, with highly specialized properties, is an excellent candidate to help answer the specific needs of a variety of structures.

SABIC Innovative Plastics can offer a range of innovative Lexan polycarbonate sheet glazing materials for flat or curved applications from train windows, to motorcycle windshields and specialty vehicle glazing. SABIC Innovative Plastics can offer materials for glazing solutions that fulfill common application requirements and also specific industry requirements, from specialty products offering superior weatherability or anti-fog properties, to grades providing enhanced impact or graffiti resistance.

Transparent sheet portfolio features

High optical quality improvements in sheet dioptry and reduction of point defects to near zero levels. SABIC Innovative Plastics has been a key supplier of top-of-the-range high optical quality Lexan and Lexan Margard® sheets. These products are able to meet the application requirements with regard to black specks, distortion and ripple. Also these products are in compliance with DIN 52305 A AZ requirements.

Variety of coatings that can offer improved abrasion resistance, weatherability, UV- and/or chemical resistance. SABIC Innovative Plastics may offer special products that can comply with taber abrasion resistance tests (DIN 52347 / ISO3537 / ASTM D1044) in the European ECE-R43 standard and North American DOT standards. Also, at SABIC Innovative Plastics' laboratories, weatherability testing is performed according to the internationally accepted Xenon ISO 4982 accelerated weathering method. Heat management innovative solar control and infrared light filtering and reflection grades to help keeping the heat build-up to minimum inside the vehicle.

Transportation glazing requirements

General requirements

- Optical clarity
- Abrasion resistance
- UV resistance
- Impact resistance

Motorcycle windshields

- Comply with US DOT requirement

Automotive glazing

- Taber abrasion < 2% / 1000 cycles-front window
- Infrared light blocking

Police vehicles

- Withstand stone impact
- Comply with Molotov Cocktail test

Military vehicles

- Ballistic laminates

Marine

- Comply with IMO regulation

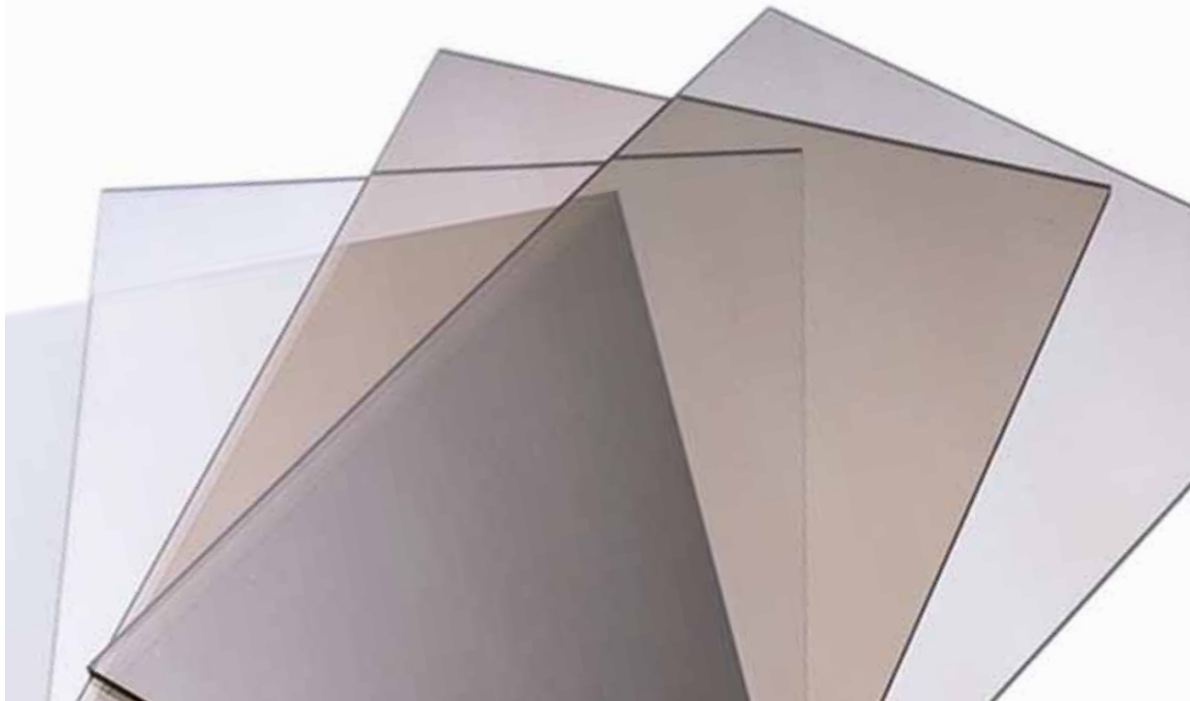
Aircraft

- Comply with specific flame/smoke/toxicity test

Agricultural vehicles

Forestry vehicles

- Tree and sawing chain Impact test



Curved applications

Hard coated, formable Lexan* Margard* sheet is an excellent candidate to make 3D-spherical and cylindrical shapes like motorcycle windshields, police vehicles and agricultural vehicles. By using conventional drape and thermoforming techniques, aesthetically appealing applications can be manufactured.

Flat applications

Lexan polycarbonate sheet can be easily cut-to-size and milled using standard machine equipment. Lexan Margard sheet complies with the requirement of the USA department of transportation and the European ECE-R43 requirements. Specific attention needs to be given to the installation† of the windows in the vehicles. The use of Lexan Margard sheet for vehicle glazing started with flat windows. First areas of use are specialty vehicles (forestry, agricultural) and police vehicles.

† Recommended adhesives and rubber gaskets can be found in SABIC Innovative Plastics' technical manuals. Not complying with these guidelines could lead to stress corrosion.

Lamination

Lexan polycarbonate sheet is an excellent candidate for lamination with acrylic and glass sheets. SABIC Innovative Plastics recommends using a polyurethane interlayer for bonding rather than a PVB interlayer due to chemical attack risk. Lexan sheet and glass laminates are used in a variety of applications, ranging from luxury car glazing, to train window cassettes, to armored vehicle glazing.

SABIC Innovative Plastics works closely with lamination industry leaders to successfully produce laminations with multi-layer and 3-D part designs. In addition to these options, SABIC Innovative Plastics offers its Lexgard®, Suregard®, and Armorgard® laminate lines.



Made from high optical quality Lexan resin, Lexan Margard MR5E sheet is UV- and mar-resistant, and virtually unbreakable. It is an excellent option for windscreens and glazing used in recreational and off-road vehicles.



Applications

Aircraft interiors

Railway & bus interiors

Automotive

Security vehicles

Motorcycle & scooters

Marine & specialty vehicles

Agricultural & forestry vehicles



SABIC Innovative Plastics' high-performance engineering resins and sheet materials are designed to help the development of next-generation aircraft interior components. These components not only will play an important role in creating the overall look and feel of future aircraft, they also deliver tough performance at a competitive capital investment.

Interior components play an important role in creating the overall look and feel of an aircraft. In a market in which competition is fierce, manufacturers need to deliver trendsetting style and tough performance with minimal capital investment. SABIC Innovative Plastics' high-performance engineering film and sheet materials are excellent candidates to help the development of next-generation aircraft interior components.



Adder cabin divider
SABIC Innovative Plastics provided parts made from Ultem® 1668 sheet to Airbus aircraft for the development of Adder cabin dividers.

Current thermoplastics material overview

Type	Color	Grades	Key Features (**)	Typical Applications
Sheet	Transparent/ Translucent	Lexan® Margard® MRAC sheet Lexan Margard FMR604 sheet	Window shades Anti-abrasion (Formable) hard coating (FMR604)	Display covers
		Lexan F2000/F2100 sheet Lexan 9600 sheet	Translucent colors Formable Textured surfaces	Light diffusers, signs Display covers
	Opaque	Lexan F6000 sheet	Many colors, Meets FAR 25.853 A&B Complex part shapes	Seat parts, table trays, Cockpit panels
		Ultem 1668A sheet Ultem 1668L sheet	Pass OSU 65/65 HR Meets FAR 25.853 A&B Chemical resistance	Fuselage interior parts Seat parts
Resin		Ultem 9075 resin	Pass OSU 65/65 HR Paint-out, molded-in color	Air-conditioning ducts lightholders, general interior parts
		Ultem 2300 resin	High stiffness parts Thin wall moldings	Interior cabin components



Sicma developed a seating cover using Lexan sheet.



Boeing selected SABIC Innovative Plastics's high-heat Ultem 1668A sheet for use in its C17 jetliner. Thermoformed by Textstars Inc., Ultem 1668A sheet forms the plane's entire cockpit. Boeing chose the material for its flame, smoke, and toxicity performance and for its exceptional impact strength.

Railway and bus industry

SABIC Innovative Plastics serves the global rail interior industry with a broad portfolio of engineered resins, sheet, and film materials. Our products are designed for both interior and exterior use, representing a total solutions approach this industry's rapidly expanding need for proven materials technologies. Azdel® Rail-Lite® composite is a new breakthrough technology from Azdel, Inc., Designed for large interior semi-structural train panels, the material is a new low-pressure, thermoformable, lightweight (specific gravity 0.6 – 0.9) composite sheet that exhibits excellent flame, smoke, toxicity, and heat-release performance (passes FAR25.853 / ABD0031). The composite also delivers outstanding mechanical properties, contributing to reduced noise, and systems costs.

Comprised of long glass fibers, Azdel Rail-Lite composite enables sturdy components with approximately half of the specific gravity of lower performing composite materials. Plus, it meets U.S. FRA 49 CFR Part 238 flammability and smoke emissions standards for train passenger cars and locomotive cabs, and complies with toxicity standard BSS 7239. It also meets Germany's DIN5510, Part 2 (S4/SR2/ST2 rating).

Internal cladding – seats and other components

Opaque sheet materials

Azdel Rail-Lite composite	Lightweight, glass-fiber-reinforced composite
Ultem® R16SG00 sheet	VO-1.6 [mm], flame resistant (ASTM E162), low smoke (ASTM E662) and toxicity (BSS 7239 and SMP 800 C)
Lexan® F6000 sheet	VO-1.5 [mm], flame resistant (ASTM E162), low smoke (ASTM E662) and toxicity (BSS 7239 and SMP 800 C)
Gepax® 7200 sheet	VO-3 [mm], flame resistant

Injection molding resins

Ultem resin	Flame retardant, chemical and heat resistant
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Windows – internal separations

Transparent sheet materials

Lexan Margard® MR5E sheet	2-side hard coated, highest optical certification and abrasion resistance
Lexan Margard MR5EFR sheet	2-side hard coated, flame resistant
Lexan Margard HLG5 sheet	1-side hard coated
Lexan Margard HLG3 sheet	1-side hard coated
Lexan FRA25/236C sheet	2-side hard coated, flame resistant (FRA type 1 certified as dual glazed system) available only in US
Lexan FRA460 sheet	2-side hard coated, flame resistant (FRA type 1 certified as monolithic sheet) available only in US

Light diffusers – signs

Translucent sheet materials

Lexan F2000 sheet	Opal white, VO-3 [mm], flame resistant
Lexan Margard MR5EFR sheet	Opal white, 2 sides hard coated, FR



Next generation aircraft interior components

SABIC Innovative Plastics' line of Ultem* sheet comprises inherently flame-retardant materials with low smoke emission. Ultem PEI sheet provides design flexibility, outstanding mechanical properties, and excellent flame, smoke, and toxicity performance. Ultem 1668A sheet can be thermoformed, pressure-formed, twin-sheet formed, or used in flat or cold-formed applications. The material can be used to mold aircraft window reveals, air ducts, sealing components, galleys, stow bins, and sidewalls, as well as seating and flight deck components. Ultem 1668A sheet meets commercial aircraft interior requirements, for FAA smoke and flammability testing and toxicity standards BSS7239 and ABD0031, and has an OSU heat-release rate below 65/65. The material is paintable or can be provided in a range of colors.



Ultem resin used for Goodrich Hella Aerospace Lighting System's New Passenger Service Unit

Exceptionally tough Lexan* sheet is based on SABIC Innovative Plastics' Lexan polycarbonate resin, and meets the aircraft industry's demands for high impact strength, excellent resistance to heat, flame and UV, and for outstanding dimensional stability at elevated temperatures. The material is available in a broad color palette for a wide range of applications that require high aesthetics.



Aircraft window mask formed with decorative films using Azdel® Aero-Lite® composite

Lexan sheet can be drape- or thermoformed into complex 3-D shapes. Plus, its low density of 1.2 g/m³ enables Lexan sheet to weigh over 15 percent less versus PVC-based materials.

Lexan F6000 sheet is another very durable material, and yet it easily forms into complex shapes with standard thermoforming equipment. This material also provides high impact resistance and heat performance, and is available in custom colors. Lexan F6000 sheet is an excellent choice for seating components, window tracks and reveals, or emergency door light fairings.



Aircraft seating is increasingly relying on Lexan F6000 sheet.

Lexan MRAC sheet and Lexan FMR604 sheet are both optical-grade products with a proprietary hard coat for maximum service life. These products offer excellent potential for window covers, lens covers, and visors.

Uncoated Lexan F2000(2100)/F2200 sheet and Lexan 9600 sheet perform well in applications such as signs and lighting covers.

Thermoplastic products certification overview

Test method

60-second vertical burn

- JAR/FAR 25.853 Section (a), 1, (I)
- ABD0031 Para 6.1.1

Heat release

- JAR/FAR 25.853 Section (d) Appendix Fm part IV OSU65/65
- ABD0031 Para 6.2

NBS smoke density

- JAR/FAR 25.853 section (d))
- ABD0031 Para 6.3

Toxicity (PPM) @ 4 minutes

- ABD0031 AITM 3.0005

Opaque materials

- Ultem 1668A/L sheet
- Azdel Aero-Lite composite
- Lexan F6000 sheet

- Ultem 1668A/L sheet
- Azdel Aero-Lite composite

- Ultem 1668A/L sheet
- Azdel Aero-Lite composite
- Lexan F6000 sheet

- Ultem 1668A/L sheet
- Azdel Aero-Lite composite
- Lexan F6000 sheet

Transparent materials

- Lexan Margard* FMR604 sheet
- Lexan Margard MRAC sheet
- Lexan 9600 sheet
- Lexan F2000/F2100/F2200 sheet

- Lexan F2000/F2100/F2200 sheet

- Lexan F2000/F2100/F2200 sheet

SABIC Innovative Plastics, Specialty Film & Sheet worked together with Masterplex convertor company on an Italian Railway project, where Lexan® F2000 sheet helped achieve the rail's most challenging interior feature a train ceiling complete with light diffusers. Suspended from a large structure, the ceiling comprises opaque and transparent grades of flame-retardant Lexan polycarbonate sheet. Its lightweight structure provides passengers with a high-quality interior and comfortable journey. Lexan F2000 sheet also offers chemical resistance, ease of processing and excellent formability.

Italian Railways also selected Lexan Margard® MR5FR sheet for the compartment separators. Transparent and hard coated on two sides, Lexan Margard MR5FR sheet provides resistance to UV-, marring, and flames [UL94, V0 at 3mm]. Its high impact strength, forced entry protection, and graffiti resistance all support SABIC Innovative Plastics' unique ten year limited warranty against breakage, and five year limited warranty against yellowing, loss of light transmission and coating failure.

Eurostar, the first truly international train that connects Paris, London, and Brussels, incorporates SABIC Innovative Plastics' Lexan Margard MR5FR sheet to create high performance light diffusers on its interior ceilings. This lightweight (DIN 53479 -1.2 kg/dm³), highly energy absorbent material provides enhanced temperature resistance and flame retardancy [UL94, V0 at 3 mm.] for the light diffuser. Plus, Lexan Margard MR5FR sheet complies with segment related certifications, such as

- ANSI Z26.1 /DOT for transportation
- EC 95/28 for flammability
- NF F31 -112 SNCF for anti-graffiti

For train exterior window and front light cover applications, Lexan Margard FMR5E polycarbonate sheet can provide high-performance dual-formable hard coat protection against wear and tear. Because this material can be drape-formed and cold-curved, it can benefit applications such as curved windows, barrel vaults, skylights, partitions, and other curved glazing applications. Additionally, Lexan Margard FMR5E sheet can provide reduced weight, high impact strength and UV- and abrasion-resistance.

Because it can be easily formed into complex, aesthetically appealing shapes, Lexan F6000 sheet is a good choice for seat backs and seat tray applications. Available in variety of colors or metallic effects, Lexan F6000 sheet also offers high impact and heat performance.



Lexan® F6000 sheet is also able to pass stringent requirements for the British Rail Standard BS 6853 Category 1A. Because of its low weight and excellent flame, smoke, and toxicity performance, the material is an excellent candidate to replace polyvinyl chloride (PVC), polyester, vinyl ester, or phenolic FRP materials used in many interior train applications. Potential target applications include interior panels, window frames, ceilings, and other large interior parts.

Ultem® R16SG29 sheet

This pioneering material is set to revolutionize the interiors of railway passenger cars and locomotive cabs as it addresses a full range of customer needs. In addition to satisfying regulations worldwide for flame, smoke and toxic emission, the material delivers exceptional cleanability, durability and vandal resistance. Its inherent design flexibility and ability to be formed into complex three dimensional shapes may enable Ultem R16SG29 sheet to realize bold new designs for window masks, cladding, walls, and seating.

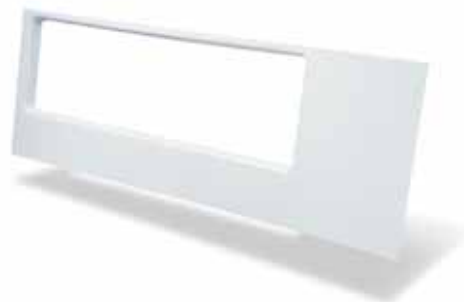
The material already forms entire rail car interiors – from floor to ceiling – on Siemens’ S70 Platform line of passenger trains for the U.S. cities of Houston, Texas, and San Diego, California. Formed three millimeters thick, the material not only meets Siemens’ demand for exceptional cleanability, durability, and vandal resistance, it also meets the several railway industry requirements for flame, smoke, and toxicity, including

- U.S. FRA 49 CFR Part 238 flammability and smoke emissions standards for train passenger cars and locomotive cabs
- Toxicity standard Bombardier SMP 800C
- Germany’s DIN5510, Part 2 (S4/SR2/ST2 rating)
- French NF P 92-501/5 and NF F 16-101 (M1,F1 rating).

Use of Ultem R16SG29 sheet is growing in train window masks, cladding, walls and seating, and other interior parts.



Train window mask from Azdel® Rail-Lite® composite used on the Long Island Railroad, New York. Azdel Rail-Lite composite, a breakthrough technology from Azdel, Inc., and SABIC Innovative Plastics, is a new low-pressure, thermoformable, lightweight composite sheet that exhibits excellent flame, smoke, toxicity, and heat-release performance in large semi-structural train panels.



Siemens train window panel made with SABIC Innovative Plastics’ Ultem R16SG29 sheet.



As the transportation industry continues to improve vehicle performance, style and safety, OEMs and suppliers have sought plastics. SABIC Innovative Plastics comes through, offering thermoforming sheets and films that meet the functional, aesthetic and safety requirements of several transportation segments, including automotive, bus, heavy equipment and recreational vehicles. Inside and out, SABIC Innovative Plastics sheet products offer a durable alternative to glass or acrylic for virtually all glazing applications, while our engineering thermoplastics have outperformed fiberglass and metal in a variety of functions.

Lexan® Margard® MR5E and MRA3 sheet both exhibit outstanding optical clarity and high impact resistance to offer excellent candidates for flat glazing applications. Compared to glass and high impact resistance, Lexan polycarbonate sheet offers a lightweight alternative for larger size automotive windows – specifically transparent roofs and rear windows.

Thermoformable, flame-retardant Gepax® and Lexan F6000 opaque sheets are available in several textures and colors to provide lightweight, impact resistant solutions for interior and exterior cladding and components. A range of Lexan films may also be used for automotive dials, audio/video remote control fascias, control panels, wet-out-window automotive displays, and back-lit applications.

SABIC Innovative Plastics' hands-on engineering support for customers covers most aspects of application development from design reviews, prototyping and testing, to thermoforming, injection molding and insert mold decoration (IMD).

Coupled with its potential environmental benefits, Lexan SLX film provides outstanding performance in demanding automotive applications. It is exceptionally weatherable with good scratch and chemical resistance, extremely strong, and tested to withstand prolonged outdoor exposure. But what customers will notice is the high-gloss finish and rich color.

To achieve exceptional aesthetics and durability, OPEL selected SABIC Innovative Plastics' Lexan SLX film for this complex part as a superior alternative to a traditional painted component. As part of SABIC Innovative Plastics' environmentally progressive initiative to help customers solve tough environmental challenges, Lexan SLX film could help avoid harmful volatile organic compound (VOC) emissions, associated with conventional paint, to lessen the impact on the environment. For the roof module, with its extensive use of glass insets, OPEL wanted a finish that would be highly polished. With a gloss rating of 110 - far exceeding that of painted steel, for example - Lexan SLX film gives paint a run for its money.



Lexan 8B36 film



Lexan 8A73 film



Lexan True-2-Form (T2F) film offers excellent formability to mold large, deep parts for high volume in-mold decoration operations



The new 2005 OPEL Zafira compact van with roof sporting Lexan SLX film



Motorcycles and scooters

More and more frequently, new motorcycle and scooter windshields are designed as spherical 3D shapes. Concurrently, U.S. Department of Transportation requirements on abrasion resistance and weatherability have grown increasingly stringent. These trends have led many manufacturers to select SABIC Innovative Plastics' Lexan® Margard® sheet with a formable hard coating for their windshield applications.

Lexan Margard FMR5XT sheet, for example, met the demanding performance criteria of Honda Italia, which used SABIC Innovative Plastics' sheet to form the windshield for its latest Pantheon model. The company's selection of Lexan Margard sheet signaled its sincere commitment to safety, quality and performance.



With safety a priority, Honda Italia Industriale SPA selected SABIC Innovative Plastics' Lexan Margard sheet for the Honda Pantheon.

Agricultural and forestry vehicles

Producers of specialty vehicles for agricultural, building and forestry applications seek to surround vehicle operators in a safe, comfortable and durable work environment. Meanwhile, vehicle designers must also confront competitive pressures, demand for cycle-time reduction, and increasingly stringent economic, regulatory, performance and manufacturing requirements. SABIC Innovative Plastics' engineering thermoplastic sheet products for body parts and glazing in agricultural and forestry vehicles can help address these concerns.

Windscreens made from Lexan Margard sheet help to provide an excellent impact resistant barrier and protection against tree branches and falling objects on a construction site. The material's superb optical quality may also help reduce eye-strain and worker fatigue.

SABIC Innovative Plastics' selection of hard-coated sheet products also offer high resistance to various chemical substances like hydraulic oils, diesel fuel, and more aggressive cleaners.

In addition, SABIC Innovative Plastics offers several thermoformable, flame-retardant opaque sheet products, available in several textures and colors. These materials are for use in exterior and interior components and claddings. Thermoformable sheet from SABIC Innovative Plastics can also be used for large body parts in construction, farm and off-road vehicles. It offers impact resistance in both weatherable and non-weatherable varieties.



Security vehicles

Vehicles designed to protect occupants against burglary, terrorism and violence cannot afford to rely on unprotected glass. The consequences of shattered glass can be potentially devastating. SABIC Innovative Plastics helps security vehicle designers meet these challenges with a line of safety and security products, including three new transparent armor laminates for glazing applications Armorgard®, Suregard® and Lexgard® laminates. The new solutions, which join SABIC Innovative Plastics' popular and proven Lexan® Margard® polycarbonate sheet, provide an additional measure of protection against ballistics, bomb blasts, natural disasters, and forced entry .

Armorgard, Suregard and Lexgard laminates deliver exceptional heat and impact resistance, along with significant energy absorption, light weight and anti-spall (the spray of glass fragments). They are tested for widely recognized standards such as ASTM, UL, HP White, NIJ and the European standards EN356, DIN 52290 PART3, EN1063, DIN52290 Part 2. These products may provide protection against many of the overpressures and fragments associated with explosions they have been tested to absorb up to 57 psi – the equivalent of 4,300 lbs of TNT detonated from 115 feet away. They also may withstand gunfire from weapons ranging from 9mm handguns to 7.62mm NATO high-powered rifles. Applications for these laminates encompass armored, VIP autos, and military vehicles.

In addition its newest products, SABIC Innovative Plastics' Lexan Margard sheet offers another potential option for security glazing designed to help prevent forced entry. It may help delay a or protect premises and property. Lexan Margard sheet will not shatter or splinter, greatly reducing the risk of accidental injury.

SABIC Innovative Plastics has teamed with Terberg - a market leader in the construction and modification of special vehicles for police, military, security and private transport - to develop several unique solutions for security vehicles. Applications include

- External surface, interior, and engine compartment protection using Gepax® sheet,
- Light diffusers and signs using Lexan F2000 sheet
- Side windows using Lexan Margard MR5E sheet
- High optical quality windscreens using Lexan ULG1003 sheet
- Glass lamination with Lexan Margard HLG3 sheet to protect vehicle and occupants from various threats, including inflammatory bombs, hand-thrown missiles, sledgehammers, pickaxes and certain ranged ballistic calibers.



Marine and specialty vehicles

Boat manufacturers, retrofitters, and suppliers can all benefit from high-performance, materials that can withstand prolonged exposure to sun, wind, water and weather. SABIC Innovative Plastics can provide solutions with a selection of marine product designed to significantly reduce routine maintenance.

Our portfolio includes lightweight, marine-grade materials for glazing and other components, such as grab rails, storage boxes, windshields, hatch covers, doors, and tackle centers.

Opaque Gepax* 8200 and 8000 sheet, for example, are excellent candidates for exterior applications that require high color stability, impact performance, UV resistance and excellent formability. Available in several patterns and colors, these durable materials can contribute to reduced maintenance operations.

Transparent Lexan* Margard* MR5E and FMR5XT sheet offer marine glazing with superb resistance from impact, abrasion, and chemical wear, making them excellent candidates for windshield, door and hatch cover applications.



A global source of innovative solutions

From specialty products offering thermoformability, light weight , excellent flame, smoke, toxicity properties, or anti-scratch performance, to grades providing enhanced resistance to impact, heat, or graffiti, the versatile range of SABIC Innovative Plastics' sheet and composite portfolio can help to create durable quality for your transportation glazing and interior components.



Ultem* film and sheet

Cutting edge performance

Based on SABIC Innovative Plastics' Ultem resin, this family of film and sheet products are made from tough, amorphous polyetherimide (PEI) thermoplastic. Combining flame, smoke and toxicity compliance, exceptional high-temperature strength and modulus, broad chemical resistance, and high quality surface finish, these materials deliver proven performance for a growing range of demanding applications. Used by leading aerospace and rail OEMs, their cutting edge performance satisfies both safety and eco-label concerns. Ultem resin's inherent flame-retardance, low smoke emission and toxicity performance makes it an excellent alternative to polyvinyl chloride (PVC) for many interior applications. Ultem sheet also enables creation of lighter parts with more consistent through-part color compared to metals and PVC blends. These performance qualities of SABIC Innovative Plastics' Ultem film and sheet products has helped it make significant gains over other conventional materials, including fiber-reinforced plastic, and sheet-molding compounds.



Metallized Ultem 1000B film utilizing sputter-coated tie layer and electroplated copper by microMetal Technologies, Inc., Newburyport, MA, USA.

Lexan* film and sheet

Broad design versatility

Compared to many polycarbonate sheet and film, Lexan sheet provides exceptional heat and impact resistance, lightweight durability, superior fire retardancy, and "crystal-clear" transparency. These outstanding properties help Lexan film and sheet create safe, durable glazing with high optical clarity.

Lexan Margard* sheet

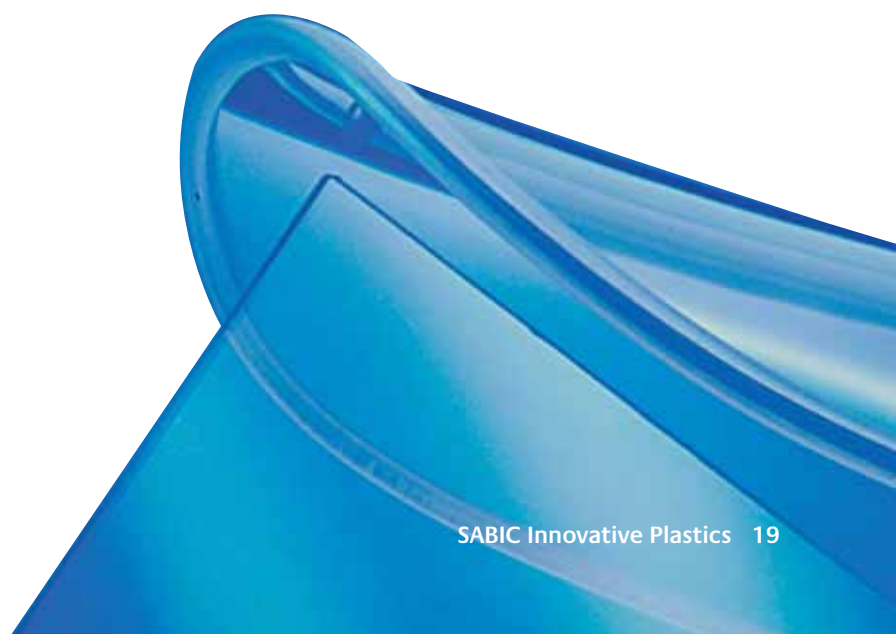
Abrasion and weathering protection combined with extra security

Made from Lexan polycarbonate, Margard sheet offers Lexan resin's remarkable performance properties. But Margard sheet also has a proprietary hard surface coating on one or both sides. This offers an added degree of resistance to abrasion and weathering. Typically these products are backed by a 5-year limited written warranty against loss of light transmission and coating failure, and by a 10-year limited written warranty against breakage.

Lexan SLX film and sheet

Excellent color and gloss retention with chemical and scratch resistance

Building on the outstanding optical clarity, impact and heat resistance of Lexan polycarbonate, these innovative materials deliver long-lasting high gloss and color by tackling UV radiation head-on. Available in clear or seven tinted colors, Lexan SLX film and sheet offers exceptional weatherability with good scratch and chemical resistance, as well as withstand prolonged outdoor exposure.



Lexan* and Margard* OQ sheet

Top optical quality

SABIC Innovative Plastics offers some of the highest optical quality sheets for vehicle glazing. Lexan and Margard OQ sheet products both meet outstanding requirements with regard to black specks, bubbles, lints and fibers, as well as distortion and ripple, meeting compliance with DIN 52305 A AZ.

Transparent armor glazing solutions

Ultra-tough performance

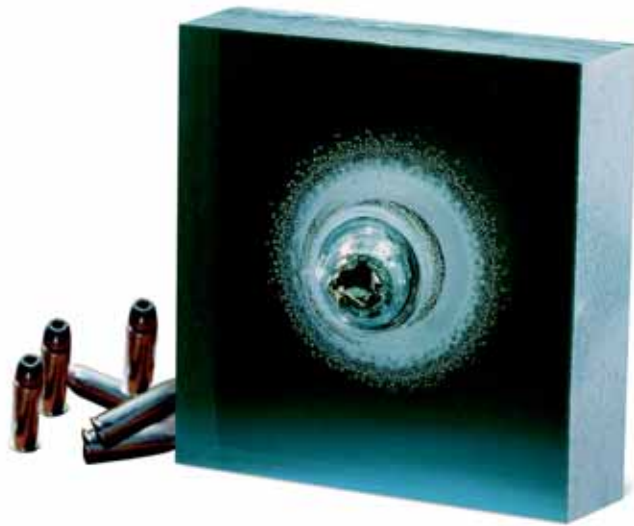
Amid heightened concerns about personal protection and security from both natural and human threats, SABIC Innovative Plastics has expanded its line of safety and security products with three new transparent armor laminates for glazing applications Armorgard®, Suregard®, and Lexgard® laminates. SABIC Innovative Plastics' line of transparent armor products offers an added measure of protection against ballistic, bomb blast, natural disaster and forced entry.

Azdel® Rail-Lite® composite

Lightweight performance and formability

Based on high performance Ultem* resin, these developmental grades combine Ultem resin's flame, smoke, toxicity and heat release properties with the structural integrity of long-glass-fiber reinforced plastics. This breakthrough technology will enable manufacturers to economically thermoform large, semi-structural parts with robust performance, significant weight reduction, enhanced safety and excellent aesthetics. Azdel Rail-Lite composite is an excellent candidate for bus and railway interior applications.

In addition to these developments, the company is working closely with coating and decorative foil suppliers to develop innovative decorative skins that can be applied in a two-step low pressure forming process.



Ultem* 1668L sheet

This recently developed material derives from Ultem 1668A sheet and is an excellent material of choice for first class and business class seats. It retains an excellent low gloss surface, even at complex part geometries. Plus, Ultem 1668L sheet provides over 10 percent weight savings versus PVC-based sheet materials, and passes OSU 65/65 heat release test and toxicity standards.

Azdel® Aero-Lite® composites

Azdel composite with Ultem resin will be a new thermoformable, lightweight composite sheet with excellent flame, smoke, toxicity, and heat-release performance for large semi-structural panels. Comprised of long glass fibers bonded by SABIC Innovative Plastics' Ultem resin, Azdel composite will help enable sturdy, lightweight components with approximately half of the specific gravity as lower performing composite materials. Potential applications include interior panels, window frames, ceilings, and other large interior parts. This material is currently under trial at key validation customers.

Colors and coextrusion

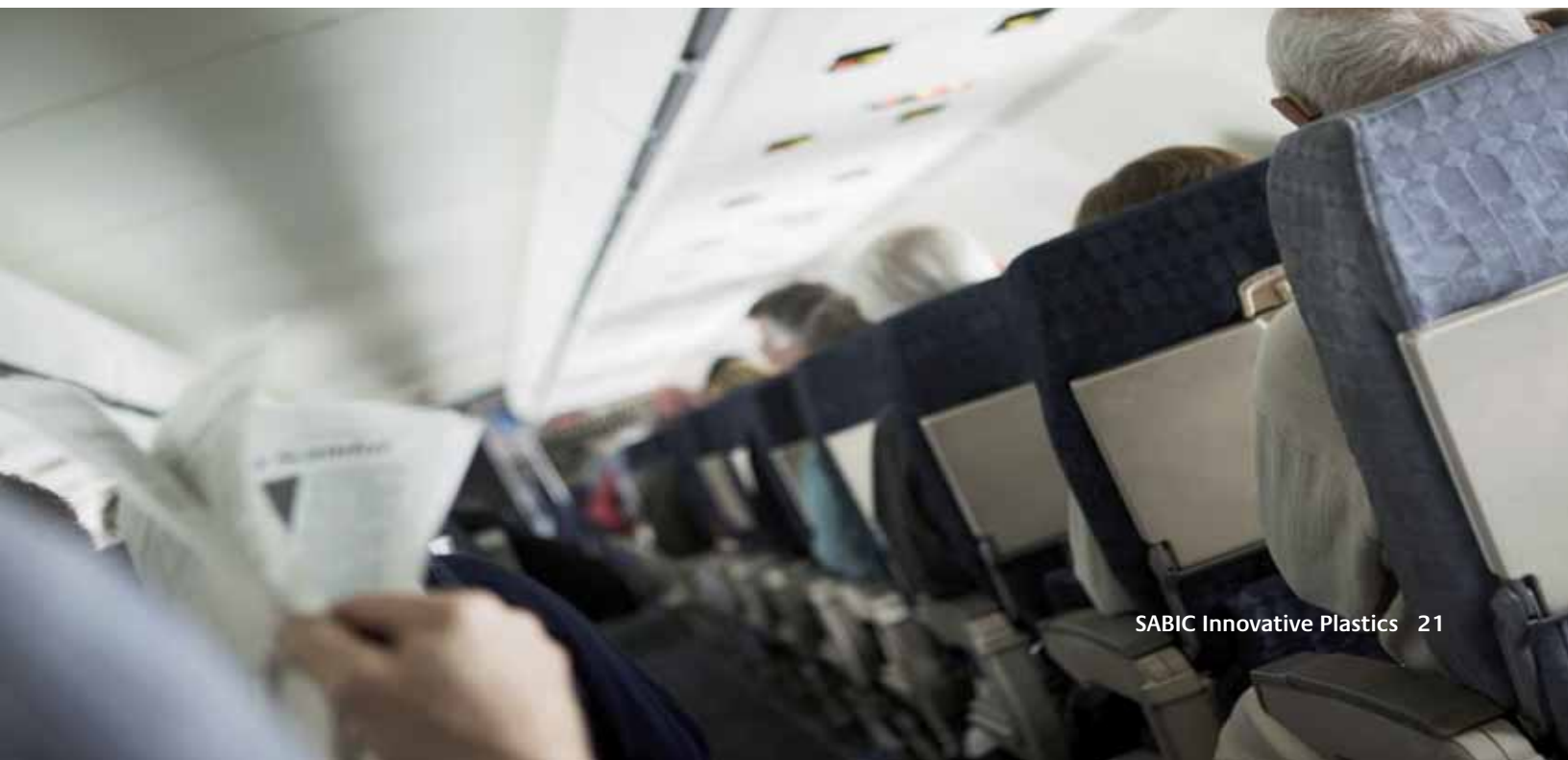
SABIC Innovative Plastics continues to develop new colors for the aviation industry. Recent developments in Lexan* F6000 sheet include metallic effects. The recently developed, white/black two layer co-extruded Lexan F5000 sheet is an excellent candidate for window shade applications.

Ultem films

Recently launched Ultem films are available in gauges from 50 to 500µm. These films are an excellent candidate for a variety of electrical and electronics applications like flexible heaters, cable insulation and insulation tapes. When metal-plated, Ultem film can be used in parts requiring EMI shielding.

Ultem fibers

Ultem resin can be spun into fiber by melt spinning or converted as a solvent-spun hollow fiber or membrane. Because the resulting threads are amorphous, they have a significantly higher glass transition temperature (215° C) than fibers made from conventional semicrystalline materials such as PPS or PEEK. Ultem fibers can be an excellent choice for applications in carpeting and seating fabrics, fire-block layers, and insulation blankets.



High level of protection against abrasion!

Lexan* polycarbonate sheet

Developed in 1953, Lexan polycarbonate resin is an amorphous engineering thermoplastic, which is characterized by high levels of mechanical, optical, electrical and thermal properties. Lexan resin is one of the most widely used engineered materials in the world and has contributed to product revolutions in virtually every industry.

Typical properties of Lexan sheet include

- High impact strength (figure 1)
- Inherent “water-clear” transparency
- Dimensional stability at elevated temperatures
- Flame resistance
- FDA compliance
- Light weight (figure 2)
- Weatherability
- Formability

High level of protection against abrasion!

Lexan Margard* sheet has a unique, hard surface coating which provides a high level of protection against unsightly scratching, so it's an excellent candidate for use in applications where frequent contact is likely.

The Taber test (ASTM-1044 / ISO 3575), developed to qualify abrasion resistance, uses a metal wheel - supported by a specific mass (normally 500 grams). The wheel is rotated a number of cycles - typically 100 or 500 - on the sheet sample. After the test the percentage of haze is measured to provide a direct indication of how much light transmission the tested samples lost. The Taber test is an excellent tool for forecasting how a material will behave in a high wear environment. The higher haze value, the lower the resistance to wear.

Material	% Haze (100 cycles)	% Haze (500 cycles)
Glass	2%	2%
Lexan Margard MRA3 sheet	3%	4%
Lexan Margard MR5E sheet	3%	9%
Lexan Margard FMR5E sheet	9%	25%
Lexan 9030 / Exell* D sheet	25%	35%
Acrylic	25%	35%
PVC	30%	36%

Falling dart impact test 5 pounds (2.3kg.) steel dart 1" (25.4 mm) diameter dip

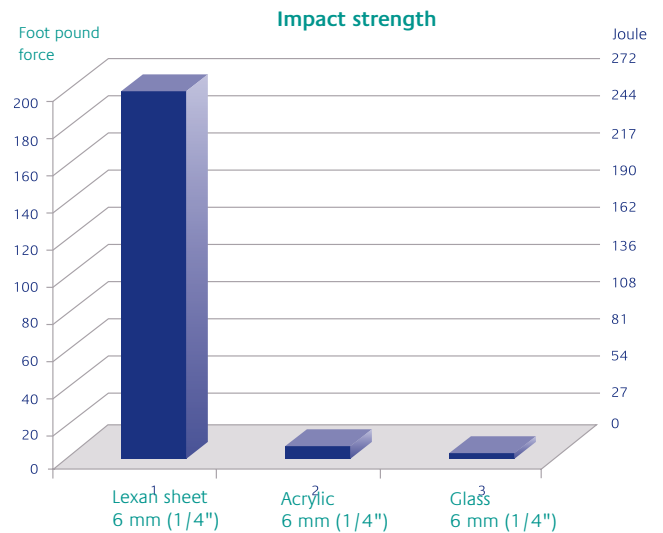


Figure 1 Impact resistance

Thickness		Polycarbonate sheet kg/sq.meter (lbs/sq.ft)	Glass kg/sq.meter (lbs/sq.ft)
mm	inch		
2	0.08	2.4 / 0.5	5.0 / 1.02
2.4	0.093	2.8 / 0.58	5.9 / 1.2
3	0.118	3.6 / 0.73	7.8 / 1.6
4.5	0.177	5.4 / 1.1	11.7 / 2.4
6	0.236	7.2 / 1.46	15.6 / 3.2
9.5	0.375	11.4 / 2.34	23.4 / 4.8

Figure 2 Weight

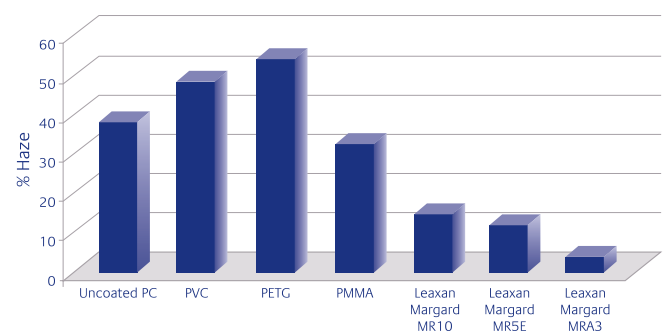


Figure 3 Taber abrasion ASTM D1044 test at 500 cycles

SABIC Innovative Plastics' Specialty Film & Sheet business is a leading supplier of high-performance engineering film and sheet products, serving customers around the world in a broad spectrum of industries and applications. Engineers, designers and technologists explore and extend the boundaries of sheet and film application development through sophisticated material analysis and advanced processing technology. These include

Technical support

- Thermoforming and tool design
- Compression and blow molding
- Aesthetic development and in-mold decoration
- Part and/or material performance testing
- Agency services

Design, structural analysis and engineering assistance

At SABIC Innovative Plastics, design assistance begins with the development of innovative concepts exploring how and where SABIC Innovative Plastics' engineering thermoplastics might enhance performance, functionality, consumer appeal and costs.

Color development

SABIC Innovative Plastics' three Customer Innovation Centers in Selkirk, New York; Bergen op Zoom, The Netherlands; and Shanghai, China all offer over 6,000 color and material combinations. They capture SABIC Innovative Plastics' knowledge of how to speed product development and combine that knowledge with the latest in color and special effects selection.

Secondary operations

Our technical experts can help you select the right painting and adhesion technology for the materials involved. We also provide consultation on drilling, sawing, trimming, embossing, metallization, cold line bending, and assembly using our materials.

With satellite development centers in the Netherlands, Japan, China and India, SABIC Innovative Plastics, Specialty Film and Sheet offers customers around the world access to a full range of laboratory, testing and design services, complemented by local hands-on technical support.

SABIC Innovative Plastics provides creative design solutions across a wide variety of industries, including transportation, electrical and electronics, building and construction, material handling, telecommunications and business machines. Whatever the industry, our company is helping to fast-track the development of value-added products that deliver pioneering performance, consistent high quality and enhanced productivity.



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